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ROYAL GARDENS, KEW.

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CXXVIII.—MANUFACTURE OF QUININE IN INDIA.

In the *Bulletin* for June 1888 the papers were reproduced in which the process was described by which either quinine separately or the total alkaloids were extracted from cinchona bark at the Sikkim plantations.

The Lieutenant-Governor of Bengal has recently communicated to this establishment a copy of the "Annual report on the Government "Cinchona Plantation and Factory in Bengal for the year 1888–89."

The following important information is extracted from it, for the information of persons growing cinchona in countries which the documents printed for the Government of Bengal are little likely to reach. It is obvious that if cinchona alkaloids can be cheaply and effectively extracted from the bark at the place where it is grown, there will be a great economy in the expense of transmitting the bark to Europe.

"*The new oil process for manufacturing quinine.*—This process has been in use for the manufacture of sulphate of quinine during the year, and no less than 2,191 pounds of that drug have been prepared by it. Arrangements have also been made for its application during the current year to the manufacture of cinchona febrifuge. Up to the year under review the new process can scarcely be said to have been

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used on a manufacturing scale. But the production of 2,191 pounds is sufficiently large to entitle it to be fairly considered as a manufacturing experiment. This enlarged experience of the working of the process only increases our confidence in it. It works without a single hitch; the bark is entirely exhausted of the whole of its alkaloid; and the quinine produced is professionally reported to be as pure in quality and as satisfactory in appearance as quinine of the best European brands. A brief account of cold oil process was submitted by me to Government in March 1888, together with a short history of its invention. The history then submitted was, however, by an unfortunate inadvertence, inaccurate in some respects; and sufficient credit was not allowed for his share in its conception and perfection to Mr. C. H. Wood, who for many years was Quinologist on the plantation. Mr. Wood has now prepared a short history of the invention, and a full account of the method of working the process. And this important and interesting paper I now enclose as appendix A. of this report. I again take an opportunity of bearing my testimony, not only to the excellence and simplicity of this admirable process, but also to the generous way in which Mr. Wood, without any pecuniary reward, initiated and invented it in his private laboratory, while Mr. Gammie perfected it in the Government Factory. Without Mr. Wood the process would not have been invented, while without Mr. Gammie it would not have been successfully applied to manufacture."

"The chief cause of the extraordinarily low price which has for some time ruled for cinchona bark, and as a consequence for quinine and the other cinchona alkaloids, is the immense exportation of bark from Ceylon. When coffee, which for a long time was the staple production of Ceylon, began some years ago to fail because of a disease which attacked the coffee tree, cinchona was largely substituted by the planters of that colony for the failing staple. And some idea of the extent to which this was done may be gathered from the following figures. During the year ending 30th September 1880 (using round numbers), one and a quarter million pounds of cinchona bark were exported from Ceylon to London. During the year 1883–84 the quantity rose to eleven millions, and the following year the quantity was about the same. During 1885–86 fifteen million pounds, and during 1886–87 fourteen million pounds were exported. In 1887–88 the quantity fell to eleven millions, and during the current year it is expected to show a further fall. The explanation of all this is simply that, when cinchona began to fail from disease and depreciation in quality, the Ceylon planters turned their attention to tea-planting with such energy that they cut down their cinchona trees to make way for tea bushes; and not being able to hold their bark, they were obliged to force it on the London market, to be sold for what it would fetch. The result has been an enormous fall in price, bark having been freely obtainable in London for several years past at prices considerably below the cost of production; and quinine having, as a consequence, fallen to a figure far below anything previously heard of. The exportation of bark from Java has also greatly increased of late years. South American bark, which a few years ago was our only source of quinine, has practically been driven out of the market. And the world has thus been drawing its supplies of quinine for some time past, chiefly from bark grown in British and Dutch colonies in Asia. The efforts of the Governments of Great Britain and Holland, to secure for their tropical subjects a cheap remedy for the commonest of all tropical diseases, have thus culminated in a more triumphant success than was ever anticipated. But this state of affairs cannot last much longer. Ceylon planters will

not go on planting cinchona trees to sell their product at a loss. As a matter of fact, planting has already ceased; and exportations are beginning to diminish. And, in the course of a year or two, the price of cinchona products must rise. The invention of the new oil process of Messrs. Wood and Gammie, and the free publication of it by Government, will no doubt contribute materially to maintain them permanently below the rates which have been hitherto considered as normal prices, because this invention makes it possible for any intelligent planter to make quinine on his own estate. From the general depression of the cinchona industry, the Government estate could not hope to escape; and from a commercial point of view, the past year has not been so good as many previous years when prices were high. But inasmuch as quinine has been materially cheapened (and thus put more within reach of the masses), the result is, I think, gratifying."

"APPENDIX A.

"*Memorandum on the fusel oil process of manufacturing quinine by* C. H. Wood, Esq., F.C.S., F.I.C., *&c., &c., late Government Quinologist to the Government of Bengal.*

"At the time I received the appointment of Quinologist under the Government of Bengal (1873), I was instructed by the Secretary of State to give my chief attention to the production on a large scale of a cheap and efficient febrifuge from the cinchona bark grown in British Sikkim; and I was specially directed to consider the suitability of the method which had been proposed by Dr. De Vrij for this purpose. It was in accordance with these instructions that the manufacture of the preparation now known as 'cinchona febrifuge' was established at Mungpoo. This preparation is made exclusively from the bark of *C. succirubra*, which at that period was the principal product of the plantations. The process selected for its manufacture was not well adapted for extracting the alkaloids from the more valuable bark of *C. Calisaya*. Several varieties of this species, however, were then under extensive cultivation, and a considerable supply of bark from this source was likely to follow. The manufacture of cinchona febrifuge from the produce of *C. succirubra* being well established, it became important to make arrangements for working up the *Calisaya* bark by some other method.

"It was obvious that the most satisfactory way of utilising this bark would be to prepare from it pure sulphate of quinine; but this could not be economically done with such crude appliances as sufficed for the manufacture of febrifuge. A suitable building furnished with the requisite machinery and apparatus was considered to be essential, and representations to this effect were made to Government by Dr. King and myself. Accordingly, in 1879, the Government of Bengal had agreed to sanction the formation of a small factory for the manufacture of pure quinine from the calisaya bark. Experiments which had been in progress for some time had enabled me to select a process for the purpose which promised to give satisfactory results. This process was to receive an extended trial in the new factory. The principal details of the method of working had been settled, and rough sketches of the apparatus made. The solvent I proposed employing in extracting the alkaloids from the bark was the 'fusel oil' of commerce. This substance is a bye-product obtained in the manufacture of spirit, and could be then purchased in London at about 9*d.* per gallon. I presume it has acquired the name of 'oil,' because it floats on water, but its chief chemical component is *amylic alcohol*. There was no likelihood of

any difficulty in the importation of fusel oil from Europe for use in the process; but should any unforeseen obstacle arise whereby fusel oil could not be got, ordinary spirit was to be used in the extraction, and Government had sanctioned its exemption from duty for such purpose. I had abundant evidence that the whole of the alkaloids could be advantageously obtained from the bark by the process I had selected; but its economical employment on the large scale depended on the use of suitable apparatus whereby the solvent could be recovered from each operation with very little loss. It was for this reason that I considered a properly furnished factory to be essential to success; and, as I have stated, the Government was prepared to sanction the expenditure necessary for this purpose.

"At this time then the arrangements were matured for starting a factory and putting the fusel oil process in operation. But at the same period there were reasons of a personal kind which made me anxious to return to England, and on this account I wished to tender my resignation. It seemed to me a suitable time for taking this step, because any successor to my appointment having to take the superintendence and control of the manufacture would naturally prefer that the factory and its appliances should be arranged under his own direction. Some informal correspondence on these points passed between the Lieutenant-Governor and myself, in which Sir Ashley Eden at first very kindly asked me to reconsider the course I wished to take; but ultimately my resignation was accepted. It was suggested that the Secretary of State would possibly select a young chemist for the appointment, who would be willing to take up and carry out the plans already made for starting the manufacture. In that case I undertook to work with him on the subject for a time in London, and render him what assistance I could in acquiring information that might be useful to him in putting the process into operation.

"I returned to England in the autumn of 1879, and a few months later I had an opportunity for making myself further acquainted with the employment of mineral oils in the extraction of quinine. The use of these agents had been already tried in India. Mr. Broughton experimented with them, but did not obtain any economical success (*see* his Report, dated 1st December 1873). Some experiments with such oils had been also made by myself, but with no very satisfactory results. Nevertheless, in some of the principal quinine factories of Europe, a process of extraction with mineral oil was being employed. Indeed, the oil process had largely superseded all others. I found that only certain kinds of oils, namely, the paraffine oils obtained in the distillation of 'brown coal,' or schist, were well adapted for this process, the products of American petroleum being unsuitable for the extraction of quinine. I procured some oil from Young's Paraffine Works, and made some trials with it in the extraction of calisaya bark from the Sikkim plantations, and obtained much better results than I had done before. Nevertheless, it appeared to me that the employment of this process in India would be attended with considerable difficulty.

Fusel oil still presented to my mind many advantages for use in that country, but I began to see the way to a further simplification in the method of employing it. In the process I had selected in India, fusel oil alone was used as the solvent. It now occurred to me that by previously diluting it with some liquid hydrocarbon a considerable improvement would result. In this case the fusel oil would be the active solvent; but the presence of a considerable proportion of a hydrocarbon, such, for instance, as any mineral oil or naphtha, would exclude some of the impurities otherwise taken up by the fusel oil when

used alone, and the alkaloids would be at once obtained in a much greater state of purity. I soon satisfied myself that the employment of a mixed solvent of this description would have many advantages over the use of fusel oil alone. But a considerable time had elapsed, and no fresh appointment to the post of Quinologist had been made. I learnt that the Government did not consider it desirable to send out another chemist. Under these circumstances, I was not in a position to make any further suggestions regarding the process of manufacture at Sikkim, and I therefore let the matter drop.

"Later on, however, I heard that Mr. Gammie, who still conducted the manufacture of febrifuge, was also attempting the manufacture of pure quinine sulphate from the calisaya bark; and a correspondence began between Mr. Gammie and myself on this subject. At about this time Dr. King came on a visit to Europe, and in the autumn of 1884 I had an opportunity of discussing with him the practicability of the efforts Mr. Gammie was making at Mungpoo. At that time a spirit process was under trial, and the results promised considerable success. The alkaloid was completely extracted from the bark, but it was associated with much impurity, and its purification rendered the process somewhat too complicated for use on the plantations. Dr. King, during his stay in Holland, had acquired some valuable information regarding the paraffine oil process as used in the Continental oil factories, and he consulted me regarding it. I was impressed with certain difficulties, which I thought would attend its employment by Mr. Gammie, and I did not feel that I could then assist him much in that direction. It seemed to me, however, a favourable moment to make a further trial of the modification of the fusel oil process to which I have already referred, namely, the employment of fusel oil diluted with some liquid hydrocarbon for the extraction of the bark. Accordingly, I resumed my experiments on the use of such a mixed solvent, and worked out two or three alternative processes. These differed from each other chiefly in the nature of the diluting hydrocarbon. In one, the mixed solvent was formed by diluting the fusel with five or six times its volume of the volatile portion of coal tar naphtha. The principle of this process I communicated to Dr. Redwood, one of the editors engaged in preparing a new Pharmacopœia, as likely to furnish the basis of a convenient analytical method for determining the alkaloidal value of the cinchona bark used in medicine, and the process is now the official test for that purpose in the present British Pharmacopœia. The use of a volatile naphtha, whether derived from coal, shale, or petroleum, for diluting the fusel oil, presented several advantages for a manufacturing process; but it was probable that there would be great difficulty in obtaining any such naphtha in India. In another of the processes I devised, the fusel oil was therefore diluted with ordinary kerosine. As this oil is so largely used for illuminating purposes in India, and is therefore so readily obtainable there, this method offered the greatest facilities for immediate trial.

"When Mr. Gammie visited England in the summer of 1885, he came to my laboratory and witnessed the experimental working of this process; and formed a favourable opinion of its adaptability for use on the plantations. On his return to Mungpoo, he began a trial of the method in extracting calisaya bark, and the satisfactory results he obtained encouraged him to go on. With great perseverance he mastered one detail after another, using only the simple appliances that he found at hand, until he was able to employ the process on a considerable scale. The valuable results, therefore, which have been thus far attained in the

practical application of the process, are entirely due to his skill and energy.

"A description of the process as it was being conducted at the commencement of this year was drawn up by Mr. Gammie, and was published with the Government Resolution of the 26th March 1888. Since then, I believe, he has effected a further improvement in the mechanical arrangements, and is now in a position to work from 3,000 to 5,000 lbs. of bark per week. A considerable quantity of quinine sulphate has been produced and issued. Samples of this have been analysed, and the results show that both in purity and appearance it is equal to the best European quinine. There appears to be no doubt that the extraction is complete, the amounts of quinine obtained corresponding well with the known composition of the bark.

"As yet only calisaya bark has been worked by this process. This bark contains a large amount of quinine associated with very little cinchonidine; consequently the final operations for obtaining pure quinine sulphate are very simple. But the plantations will also furnish much bark, especially from hybrids, which contain a considerable amount of quinine associated with a large amount of cinchonidine. Such bark will no doubt be utilised in the preparation of pure quinine as soon as the further arrangements necessary for separating the extracted alkaloids are provided. *Succirubra* bark can be as readily extracted by this method as any other; and it seems that from the acid solution of the total alkaloids so obtained, "cinchona febrifuge" can be prepared equal in every respect to that hitherto prepared by the acid process, and with the advantage of a greatly increased yield.

"Comparing this process of extraction with others that have been tried in India, the chief advantages it presents appear to be—(1) that the alkaloids are completely extracted from the bark in a much greater state of purity, so that the final operations for obtaining pure and finished products are much simplified; (2) that the whole process of extraction can be performed at common temperatures; (3) that the apparatus and appliances required are all of a simple character, and therefore well suited for use on the plantations.

"No very exact estimate can yet be formed of the cost of manufacturing quinine and other alkaloids by this process. It is only now slowly passing from the experimental stage, which is necessarily an expensive one. Further improvements conducing to greater economy are probable. But even as it is, I gather from Dr. King, under whose skilful superintendence all efforts at local manufacture have been so ably fostered, that quinine can be produced on the plantations at a cost not exceeding the present unprecedentedly low market price of the valuable medicine."

CXXIX.—MAQUI BERRIES FOR COLOURING WINE.

(*Aristotelia Maqui.*)

The Maqui is a small evergreen tree or shrub common in Chili along the course of torrents and in shady, mountainous woods. It belongs to the linden order (*Tiliaceæ*), which abounds in species, the inner bark or bast of which affords fibre of more or less value. The most important are jute and the linden from which the well-known Russia matting is made. The Maqui also affords a fibre which is used in Chili for cordage. It is easily cultivated in gardens in the south of England, and at Kew grows vigorously with the protection of a wall. Whether

its cultivation for the production of fibre would pay is doubtful, looking at the profusion of excellent fibre plants which are not woody which are now known.

In Chili the fruits of the Maqui are eaten either fresh or preserved in different ways. Mixed with grapes, a wine is also made from them. The shrub varies with either dark purple or greenish white berries; the latter are preferred in Chili.

A curious industry has sprung up of late years in the collection and export to Europe of the berries for the purpose of colouring wine. For the particulars contained in the following letter Kew is indebted to the Consul-General for Chili. The Maqui flowers freely at Kew, but rarely fruits. Its cultivation for the sake of the berries would, therefore, be precarious in England, but would probably present no difficulty in Southern Europe.

The first notice of the introduction of Maqui berries into Europe is apparently that given by J. Poisson in the Revue Horticole for 1886, p. 467. He suspected that they were intended for the colouration of wine, a purpose for which he stated that elder berries were already employed in France. He explains that the object of adding the berries to grapes in making wine in Chili was for the sake of the colour. No doubt it occurred to some ingenious person to extend their use in a dried state for the same purpose to the Old World.

Senor Juan de la C. Cerda, Consul-General for Chili, to Royal Gardens, Kew.

Consulado General de Chili, 3, Cork Street,
London, W., December 17, 1889.

Dear Sir,

In reply to your kind letter of the 14th instant, I am sorry to inform you that I do not know where you could get some fruits for your museum of the *Aristotelia Maqui*: but I am writing to my friends in Liverpool and Glasgow, and as soon as I have any information I will let you know. Probably I may get some fruit, and if I do I will be very pleased to hand it to you.

The common name of this fruit in Chili is Maqui, the same as the plant, and it is cropped from the wild shrub in the forests. It is not cultivated at all.

I think that the attention of farmers will be very soon drawn to the cultivation of this important plant, in consideration of the great development in the exportation of its fruit to Europe in the last three or four years for colouring wines.

The total of this exportation was 26,592 kilos, worth $2,234, in 1884; 136,026 kilos, worth $10,882, in 1886; and 431,392 kilos, worth $34,515, in 1887; of which the exportation to France was 500 kilos in 1884, 115,000 in 1886, and 315,774 in 1887. I have no statistics for 1888 and 1889, but it is to be supposed that the increase may have been in the same proportion.

Wine is not produced from this plant, but ribbons from the stems for fastening in farming purposes are usual, and easily made without any preparation, simply by hand.

I think it would be a good benefit for Chili as well as for England, where this shrub grows in the open air, to carry out an experiment with two or three small stems of the nice specimen you have in the Gardens by passing the ribbons of these stems produced by hand through any scutching machine, in order to ascertain the value of its fibres for textile purposes.

Any other particulars you may need about the Maqui plant I shall be very pleased to inform you.

I remain, &c.
(Signed) JUAN DE LA C. CERDA.

CXXX.—VINE CULTURE IN TUNIS.

While the ravages of the Phylloxera in France have diminished the production of wine in that country, the diminution has not probably affected the great export trade of Bordeaux. The whole Mediterranean basin has been drawn upon either for raisins or wine to make up the deficiency. How this is effected it would be somewhat outside the scope of these pages to discuss. But the previous note is not without its significance in the matter. The result has been to stimulate the cultivation of the vine in other countries. And of this the following correspondence affords an illustration.

FOREIGN OFFICE to ROYAL GARDENS, KEW.

SIR, Foreign Office, November 22, 1889.

I AM directed by the Secretary of State for Foreign Affairs to transmit to you, to be laid before Mr. Thiselton Dyer, the accompanying despatch respecting vine culture in Tunis.

I am, &c.
The Assistant Director, (Signed) JAMES FERGUSSON.
Royal Gardens, Kew.

MY LORD, Tunis, November 18, 1889.

THE Tunis Official Journal of the 14th instant publishes a report by the Inspector of Agriculture on the wine produce of the Regency during the past year, showing that the production has increased from 15,000 hectolitres in 1888 to 32,600 hectolitres in 1889.

The plantation of vines has been extended since 1888 by 759 hectares, bringing the total area of vineyards to 5,200 hectares.

The grape harvest was satisfactory, both as regards quantity and quality, and the most successful wines were extracted from the latest crops in September.

I have, &c.
The Marquess of Salisbury, (Signed) R. DRUMMOND HAY.
&c. &c. &c.

CXXXI.—PHYLLOXERA IN VICTORIA.

The note in the Bulletin for September 1889 on the Phylloxera in South Africa has led Sir Ferdinand von Muëller, the Government Botanist in Victoria, to address the following communication to Kew. No doubt the circumstance to which he refers is liable to recur elsewhere. The only really satisfactory way of replanting land with vines which has been infested with Phylloxera is to use vines grafted on American stocks.

Sir F. VON MUËLLER, K.C.M.G., F.R.S., &c. (Government Botanist) to ROYAL GARDENS, KEW.

DEAR MR. DYER, Melbourne, October 21, 1889.

ONLY a few hurried words this time to say that I read the able report on measures against Phylloxera as adopted in South Africa with very great interest in your admirable *Bulletin* (September 1889). But

I would like to mention at once that the Phylloxera Commission of Victoria found at Geelong that even after five or six years remnants of roots of destroyed vines were beset with Phylloxera. It is, of course, impossible to eradicate it with completion, and thus, here in this moist clime at all events, the insect will continue to wander from fragment to fragment of the remaining roots. Thus then it would defeat the object in view if, as recommended in the South African report, any replanting was effected on former Phylloxera ground already after three years. I will endeavour to speak to his Excellency Sir Henry Loch on this subject before his departure to South Africa.

I am, &c.

W. T. Thiselton Dyer, Esq., C.M.G., F.R.S., &c. (Signed) Ferd. von Muëller.

CXXXII.—BOTANICAL EXPLORATION OF CUBA.

The well-known botanist, Baron Eggers, formerly Commandant in the Danish Colony of St. Thomas, has for some time devoted himself to the botanical exploration of the West Indian islands. He has made important collections in San Domingo and the Bahamas, the flora of which is still most imperfectly investigated. The following letter gives some interesting particulars of his work in Cuba.

The *Bulletin* for December 1887 contained an account (with a figure) of the tree producing Sabicu wood (*Lysiloma Sabicu*), formerly believed to be peculiar to Cuba, but now known to be identical with the Horse-flesh Mahogany of the Bahamas.

Baron H. Eggers to Royal Gardens, Kew.

Frederiksborg, Denmark,
July 8, 1889.

Dear Sir,

Having now returned from my voyage to Eastern Cuba, I am at present engaged in arranging my collections for distribution; among others the most complete set for the Kew Herbarium according to your wish.

The country I have explored this time comprises the southern part of Eastern Cuba, from the coast over the mountain ranges into the interior somewhat beyond the middle of the island.

The mountains here are only of moderate height, between 1,500–2,500 feet, some few up to 3,000 feet, formed chiefly of limestone, and covered with a dense forest, which is very little broken by small coffee estates, of which a great part were burned down and ruined in the late ten years' insurrection, which terminated in 1878, so that the country in all those places has relapsed again into a wilderness. There are a number of small streams but no large rivers and no lakes or swamps.

Of interesting plants that I have collected, I may name a great number of ferns, among which there are many I had not met with yet, neither in San Domingo nor the other islands.

Among the trees you will especially be interested to hear about the Sabicu or Horse-flesh. This tree in Cuba is evidently the same as that found last year in the Bahamas by me; it grows in Cuba to a great height, and is not uncommon in the higher districts. It flowers in April; flowers, white, very abundant, but lasting only a few days, when the whole tree is devoid of flowers again. The young leaves when sprouting forth in March are almost red, by which the trees are easily recognised in the forest. The wood is utilised for timber and also exported. The name of the tree in Eastern Cuba is not Sabicu but Jiqüe, by which it is commonly known among the peasantry. Sabicu is its name in the western part of the island, from whence most likely it has been first exported. The curious fact is, that many plants have

different names in the eastern and western parts of the island, which in many other respects also are often very different. There are specimens in flower in the set made up for Kew.

Other interesting trees are *Cedrela odorata*, which, however, you know from Jamaica also. The *Copaifera hymenæifolia*, on the other hand, I believe, is only Cuban. This is a large and valuable timber-tree of the lowlands; it is called Cagüeyran, and is much used for building purposes. The pine seems to be the same as the one in San Domingo. I did not obtain any flowers of the Cuban species. A curious feature about the pine is that here it grows among the ordinary woods, and not so much isolated as in San Domingo.

The sour orange is most common in all woods, apparently indigenous, as it is found in what in Cuba is called the monte firme or virgin forest.

Phajus grandifolius I found also not uncommon along little rivulets in the forests.

Of Cycads a *Zamia* was found of which I send you the leaves, as no flowers were found. The root of this species was often eaten by the insurgents during the war, but only after washing it carefully, as it is said the flower obtained from it otherwise is poisonous. It is called Yuguilla, the common Cassava being called Yuca.

Very few palms were found in flower. The most common is of course the *Oreodoxa regia*: then there is a gregarious palm, called the Palma justa; a *Bactris*, very spiny; the Corrojo (*Acrocomia*), the Yarey, a large fan-palm, several *Thrinax*, &c.

Some very interesting bast was obtained from three different trees. The finest of a lace-bark tree, called Guana (*Lagetta lintearia*); the Guacocoa (from *Daphnopsis Guacacoa*) very white and strong; and finally the Majugera (from *Paritium elatum*), the common Cuba bast very much used for ropes. This tree grows to an immense size. I have seen trunks 18 feet in circumference. I send you samples of all three kinds for the Kew Museum. Among ferns there were a number of arboreous ones, also *Ophioglossum palmatum*, three feet long, hanging from trees. A *Brunfelsia* with large blue flowers seems to be a new species.

I am, &c.
(Signed) H. Eggers.

W. T. Thiselton Dyer, C.M.G., F.R.S.

CXXXIII.—THE SUGAR PRODUCTION OF THE WORLD.

An extremely able and interesting report on the "Progress of the Sugar Trade," by Robert Giffen, Esq., LL.D., Assistant Secretary, Commercial Department, Board of Trade, was presented to Parliament in May of last year, and issued to the public in the month of June following. For an early copy of it this establishment was indebted to the Board of Trade. The whole document deserves the most careful study. But it is unlikely in its complete form to circulate to any large extent in the Colonies. It seems desirable, therefore, to extract some passages which contain information in a very condensed form on the production, consumption, and, to some extent, distribution of sugar.

There is some risk, no doubt, that by detaching passages from a document of this kind a different impression may be produced to that which would be derived from the whole. The passages now reproduced deal, however, with statistical matters of fact, which are not affected whatever view is taken of their significance.

Taking the period 1853–87, the production of cane sugar has more than doubled; and British and foreign cane sugars have preserved about the same proportion. In 1887 British cane sugar formed about one fifth of the whole production of cane sugar and about one ninth of the total sugar production of the world. The development of the beet sugar industry is brought out in the most remarkable way. At the beginning of the period it formed only one eighth of the total sugar production; at the end it amounted to nearly a half.

Taking the West Indies and British Guiana together, it appears that since 1883–5 the production of cane sugar has pretty well held its own. But if the production of the West Indies be taken separately, it "has not maintained itself so well."

Turning now to consumption, it appears that there has been a falling off, during the period 1877–88, in the importation of raw cane sugar into the United Kingdom from British possessions, "particularly the West Indies," of nearly 2¼ million cwts., the greater part in the last five years. Foreign raw cane sugar over the same period ends with a slight decrease. On the other hand, the West Indies have found a market elsewhere, particularly in the United States. The importation of beetroot sugar during the same period has more than doubled. And it is important to notice that during the last five years, while the import of raw beet sugar showed little increase, that "of refined in the same period has "been over three million cwts., or as much as the total imports of "refined from beet countries five years ago."

The production of cane sugar in British possessions show "that that "production does not find an outlet in the market of the United "Kingdom, as it formerly did, its place being there taken by beet "sugar."

The figures with regard to home consumption are very striking. "The 8 million cwts. consumed 30 to 35 years ago, inclusive of "duty, were as costly to the consumers of the United Kingdom as "the 22 million cwts. annually consumed in the last two or three "years."

In the June Bulletin for 1887 the position of the sugar question in the West Indies was briefly touched upon. There is reason to think that to some extent sugar has slightly gone out of cultivation. When this has happened the particular loss is irreparable. The necessity of keeping the land clean and in tillage, and the machinery in working order, is so paramount that there can be no doubt a sugar planter will strain his pecuniary resources to the uttermost before throwing his estate out of cultivation, because once a sugar planter is compelled to suspend operations, even for a short period, the capital invested is lost beyond hope of recovery. The usual sequence of events, when an estate is abandoned in the West Indies, is that the workpeople are scattered and leave the neighbourhood, the land becomes foul, the buildings ruinous, the working oxen are sold, necessarily at the loss incidental to a forced sale, and the machinery, in spite of every precaution to keep it in order, becomes rusty and useless. Hence it will be no matter of surprise to learn that it is impossible to resume operations on an abandoned sugar estate in the tropics, except at a cost almost equal to that of starting an entirely new undertaking.

If, therefore, the figures supplied by the Board of Trade do not justify a gloomy view of the present position of the cane sugar industry in British Colonies, they scarcely justify a very optimistic one. It is obvious that the capital which should be applied to the improvement of manufacturing processes and machinery is, under present circumstances, practically diverted to the mere maintenance of the cultivation.

And this in the long run must be a losing game. At present the fact stands that West Indian sugar has to a large extent been driven from the home market to that of the United States. If in time it should lose that, its fate apparently is sealed.

I.

TOTAL PRODUCTION OF DIFFERENT KINDS OF SUGAR, 1853–87.

—	1853–55.	1886–87.	Increase.
	Tons.	Tons.	Tons.
"British cane sugar - - -	261,000	580,000	319,000
Foreign cane sugar - -	972,000	2,174,000	1,202,000
	1,233,000	2,754,000	1,521,000
Beetroot sugar - - - -	190,000	2,433,000	2,243,000
Total - -	1,423,000	5,187,000	3,764,000

"Out of a total increase of production amounting to $3\frac{3}{4}$ million tons, no less than $2\frac{1}{4}$ million tons, or about 60 per cent., is an increase of beet sugar, which has in fact changed its position as a factor in the production altogether, having now reached the point of being nearly equal to cane sugar, whereas at the beginning of the period it supplied only about one-eighth of the total production. Both British cane sugar and foreign cane sugar have more than doubled in the same period, and the increase in the two together amounts to $1\frac{1}{2}$ million tons, or 40 per cent. of the total increase of $3\frac{3}{4}$ million tons; and this increase also is obviously a very large one. It hardly compares, however, with the increase in beet sugar, which is, to a large extent, a new development altogether. Of course this table is subject to the observation that the figures in the last two or three years are specially increased by the inclusion of one or two countries formerly omitted; but a correction on this account can easily be made if thought necessary in a comparison extending over so long a period.

"This is the aspect of the progress when the beginning and end of the whole period, 1853–87, are compared. In the interval of five years, between 1880–82 and 1886–87, the figures are :—

"INCREASE OF PRODUCTION OF DIFFERENT KINDS OF SUGAR, 1880–87.

—	1880–82.	1886–87.	Increase.	1886–87 (deducting countries included since 1884).	Increase.
	Tons.	Tons.	Tons.	Tons.	Tons.
"British cane sugar -	419,000	580,000	161,000	531,000	112,000
Foreign cane sugar - -	1,499,000	2,174,000	675,000	1,973,000	474,000
	1,918,000	2,754,000	836,000	2,504,000	586,000
Beetroot sugar - -	1,646,000	2,433,000	787,000	2,433,000	787,000
Total - - -	3,564,000	5,187,000	1,623,000	4,937,000	1,373,000

"Thus the increase in the most recent period, keeping strictly to the basis before 1884, amounts to 1,373,000 tons, of which three-sevenths may be credited to cane sugar, and four-sevenths to beet sugar. The progress of beet sugar is thus in amount as great as ever, though the per-centage increase is not quite so great as in the early part of the period since 1853. The most remarkable part of the increase of beet was, no doubt, prior to 1882.

"It will be noticed also that after about 1870 the proportion of British cane sugar in the total production was maintained steadily at about 12 per cent. until about two years ago, so that the great growth in the proportion of beet in the total production was obtained in that period at the expense of foreign cane sugar, which, in fact, declined from 54 to 39 per cent., while beet rose from 34 to 49 per cent.; but in the latest two or three years the proportion of British cane sugar in the total has been barely maintained, having fallen to 11 per cent., while foreign cane sugar has recovered a little, and beet has fallen back a little. The proportion of British cane sugar was also much higher in the earlier periods than it has since been, ranging then between 17 and 20 per cent.

"Still, at no period has there been anything but an increase in the growth of British cane sugar, though it has not kept pace with the growth of beet sugar, and in the last year or two with the growth of foreign cane sugar."

II.

Production in the West Indies.

"The average annual exports of the West Indian Colonies (including British Guiana) which have always been specially interesting in this question of production, have been as follows:—

1877–79	- -	5,205,000 cwts.	= 260,000 tons.
1880–82	- -	5,548,000 „	= 277,000 „
1883–85	- -	6,062,000 „	= 303,000 „
1886–87	- -	5,920,000 „	= 296,000 „

"Since 1883–85 the West Indies have thus held their own, the difference between 303,000 tons in 1883–85 and 296,000 tons in 1886-87 being nominal only; but they have not more than held their own in these most recent years, although there is still an increase since 1880–82.

"It will be seen, moreover, from the summary in the Appendix, that the production in the West Indies, exclusive of British Guiana, has not maintained itself so well on the average of years as the production in British Guiana. The production in both cases in 1887 is about the largest on record; but the average of the West Indies, excluding British Guiana, for the two years 1886–87, is brought down by an extremely low export figure in 1886."

III.

Displacement of Cane by Beet Sugar.

"The great increase of the production of cane sugar, again, has been an increase for consumption in extra-continental countries, principally the United States and the United Kingdom; but a certain surplus of the beet production has also overflowed into those extra-continental

countries, principally the United Kingdom. This has been done, however, without diminishing the consumption of cane sugar in those countries taken altogether, although the United Kingdom in recent years has come more and more to rely largely on beet sugar, and the supply from certain cane sugar districts, particularly the West Indies, has of late rapidly diminished, these districts in turn having found a market elsewhere, particularly in the United States, for their increased production. This disposal of the overflow of beet sugar, and partial displacement of cane sugar in its proportionate importance in the market of the United Kingdom, are points of special interest . . . which may be further illustrated."

ANNUAL IMPORTS of SUGAR into the UNITED KINGDOM, distinguishing CANE from BEETROOT SUGAR, &c.

——	1877-78.	1882-83.	1886-88.	Increase or Decrease in 1882-83 from 1877-78.	Increase or Decrease in 1886-88 from 1882-83.
Raw cane sugar from British Possessions.	Cwts. 5,450,000	Cwts. 5,168,000	Cwt. 3,292,000	Cwts. − 282,000	Cwts. − 1,876,000
From foreign countries	7,100,000	8,073,000	6,585,000	+ 973,000	− 1,488,000
Total - -	12,550,000	13,241,000	9,877,000	+ 691,000	− 3,364,000
Raw beetroot sugar -	3,220,000	6,861,000	7,456,000	+ 3,641,000	+ 595,000
Refined cane sugar -	215,000	125,000	748,000	− 90,000	+ 623,000
Refined beetroot sugar, *i.e.*, refined sugar from beet-growing countries.	3,132,000	2,900,000	5,999,000	− 232,000	+ 3,099,000
Total - -	19,117,000	23,127,000	24,080,000	+ 4,010,000	+ 953,000

" Thus, beetroot, though it increased largely in the five years ending 1882–83, did not gain at the expense of cane sugar, but since the date mentioned the gain has been largely at the expense of cane sugar, both in amount and proportion, and in the whole 10 years since 1878 there is a loss of cane both in amount and proportion, and a gain of beet. The imports of raw cane sugar from British possessions alone have diminished in the 10 years from nearly $5\frac{1}{2}$ million cwts. to about $3\frac{1}{4}$ million cwts., or a diminution of $2\frac{1}{4}$ million cwts., the greater part in the last five years. At the same time the imports of raw cane sugar from foreign countries, which increased nearly 1 million cwts. in the first five years, show a falling off of about $1\frac{1}{2}$ million cwts. in the subsequent five years, making a small net balance of decrease in the 10 years. Sugar from beet countries, on the other hand, has more than doubled in amount in the 10 years, the increase being from 6,350,000 cwts. raw and refined together in 1877–78, to 13,455,000 cwts. in 1886–88. There is a notable difference, moreover, in the apportionment of this increase in the two quinquennial periods. Between 1878 and 1882 the increase of the imports from beet countries was of raw sugar, the imports of refined rather diminishing. Since 1882 the increase of the imports has only been to a small extent in raw sugar, and the increase of refined in the same period has been over 3,000,000 cwts., or as much as the total imports of refined from beet countries five years ago.

IV.

Change of Market for British Cane Sugar.

"The prominent fact . . . . . is the changed amount and proportion of the imports of cane sugar from British possessions. Writing in 1884 . . . . I pointed out that while the amount of the imports from British possessions was maintained at nearly the high figures of 1853 and subsequently, yet the *proportion* of these imports to the total had steadily declined, owing to the large growth of imports from other countries, especially beet countries. In the last five years a still greater change has taken place. The imports from British possessions have greatly diminished, from nearly 5,000,000 cwts. in 1882, to just over 3,000,000 cwts., and the proportion, which had steadily fallen from 65 per cent. in 1853–55, to 23 per cent. in 1880–82, has since farther fallen to 13·7 per cent. only. These are not the figures of production in British possessions, which have already been dealt with, and which have not diminished, but they show that that production does not find an outlet in the market of the United Kingdom, as it formerly did, its place being there taken by beet sugar."

V.

Increase of Home Consumption at Diminished Cost.

"The net effect, however, is that for a good many years the great increase in the quantities of sugar consumed in the United Kingdom has been accompanied by an actual decrease in the aggregate sum spent upon it by consumers in the United Kingdom. The 1,100,000 tons and upwards now consumed annually cost only in the last two years about 16,500,000*l.* annually, whereas the 900,000 to 1,000,000 tons consumed seven or eight years ago cost from 20,000,000*l.* to 24,000,000*l.* The comparison is even more striking if we go farther back. The 8,000,000 cwts. consumed 30 to 35 years ago, inclusive of duty, were as costly to the consumers of the United Kingdom as the 22,000,000 cwts. annually consumed in the last two or three years. Of course this is again subject to the above qualification as to final consumption by the people of the United Kingdom, but the reduction of price is also an important matter for the manufacturing industries in which the sugar is used."